EVALUATING RADIOACTIVE AIR EMISSIONS FROM SAMPLED STACKS

Purpose

This Air Quality Group procedure describes the methods used by ESH-17 to evaluate radioactive air emissions from sampled stacks, as part of the quality assurance process for ensuring compliance with Rad-NESHAP requirements.

Scope

This procedure applies to non-LANSCE radioactive stack emissions and includes both tritium and particulate/vapor emissions.

In this procedure

This procedure addresses the following major topics:

Signatures

Prepared by: Scott Miller, Rad-NESHAP Project Leader	Date: 12/14/98
Approved by: Terry Morgan, Quality Assurance Officer	Date: 12/14/98
Approved by: Doug Stavert, ESH-17 Group Leader	Date: 12/15/98

General information

Attachments

This procedure has no attachments:

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	2/5/96	New document.
1	3/6/97	Process and management changes
2	12/16/98	Process and management changes

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- ESH-17 personnel tasked with performing all or part of this procedure.

Training method

The training method for this procedure is “self-study” (reading) and is documented in accordance with the procedure for training (ESH-17-024).

Prerequisites

In addition to training to this procedure, the following training is also required prior to performing this procedure.

- ESH-17-024, “Personnel Training and Orientation”
- ESH-17-026, “Deficiency Reporting and Correcting”
- ESH-17-112, “Tritium Stack Emission Calculations and Reporting”
- ESH-17-114, “Calculation of Radioactive Stack Emissions”
- ESH-17-118, “Categorizing and Reporting Increased Airborne Radioactive Emissions from Sampled Stacks”
- ESH-17-501, “Dose Assessment Using CAP88”

Hazard Control Plan

The Hazard Control Plan that documents the hazards of work described in this procedure is:

- ESH-17-Office Work

This plan is on file in the ESH-17 group office.

General information, continued

Definitions specific to this procedure

Minimum Detectable Emission (MDE): The minimum stack emission that can be detected. The MDE is based on the minimum detectable activity (MDA) for gross alpha and beta counting, along with reported sample flow rate and reported stack flow rate.

References

The following documents are referenced in this procedure:

- ESH-17-024, "Personnel Training and Orientation"
- ESH-17-026, "Deficiency Reporting and Correcting"
- ESH-17-102, "Determination of Release Point Potential Effective Dose Equivalent"
- ESH-17-112, "Tritium Stack Emission Calculations and Reporting"
- ESH-17-114, "Calculation of Radioactive Stack Emissions"
- ESH-17-118, "Categorizing and Reporting Increased Airborne Radioactive Emissions from Sampled Stacks"
- ESH-17-121, "Sampling/Monitoring Radioactive Particulates, Tritium, and Gases from Exhaust Stacks, Vents, and Ducts"
- ESH-17-501, "Dose Assessment Using CAP88"
- Title 40 Code of Federal Regulations Part 61, Subpart A, "General Provisions," December 15, 1989

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

This procedure is divided into several parts. Not all parts will be performed each time the procedure is used. Only those parts that are applicable to the evaluation being performed need be done.

Evaluating a data set

Data set evaluation

Evaluating a data set in accordance with this procedure is limited to determining expected emissions values and their expected ranges. Guidance for performing this evaluation is provided below. Realizing that additional evaluations may be necessary to ensure quality data, additional evaluations may be performed as needed.

Evaluate the data sets when:

- emissions consistently exceed the expected range,
- facility operations or conditions change in a manner that may affect emissions, or
- best judgment indicates an evaluation should be performed.

Document the evaluation, including, at a minimum, any assumptions made and/or conclusions reached.

Steps to evaluate a data set

To evaluate a data set, perform the following steps:

Step	Action
1	Choose the data set that represents the emission of interest (e.g., alpha activity). Address the following criteria: • Is the data set representative of expected operations and conditions? (e.g., it is pointless to determine an expected emissions value for shutdown conditions if the facility is about to begin operating). In some cases (e.g., new operations or new configuration), it may not be possible to choose a representative data set. In these cases, choose the most representative data set available. Verify this choice as data become available. • Were data used to develop the data set collected in a similar manner as is expected in the future? For example: ⇒ Are analytical count times and MDA values consistent? ⇒ Were sample/stack flow rates consistent? ⇒ Were the instruments used for analysis consistent?

Evaluating a data set, continued

Step	Action
2	Calculate an emission rate for each data point in the data set. This will nullify the time dependency of the measurement. For instance, if 100 μCi of alpha activity were emitted from a stack over a period of 100 hrs, the emission rate is calculated to be 100 μCi/ 100 hrs, or 1 μCi/hr. This is the value that should be used for comparison.

Identifying outliers

Within a data set, some data points may illustrate extreme behavior. This may be the result of analytical error, but may also be the result of a planned or unplanned special situation. Since the goal of this evaluation is to determine expected emissions, such extreme cases should not be included in the process, and must be identified and removed from the overall evaluation. These outliers will, however, continue to be reported as emissions from the stack.

Guidance for the identification of these outliers is provided below. Since special cases may arise for which different methods are needed, it is up to the best judgment of the person performing this procedure to determine how to identify the outliers.

Steps to identify outliers

To identify outliers, perform the following steps:

Step	Action
3	Several statistical methods are available for identifying outliers in a data set. Some examples are "Z" scores and control charts. Use either of these methods (or another statistically valid method) to identify outliers.
4	After identifying an outlier, ensure that the data point was calculated correctly. If an error is found, correct the mistake and repeat the test for outliers. Identify all true outliers. Do not include these outliers in this evaluation. **Note**: If the outlier is an indication of a change in operations or conditions, it may not be an outlier in future dataset evaluations. As such, include these values in subsequent dataset evaluations. If the outlier is the result of an unplanned release or from an accident situation, it may be omitted from subsequent dataset evaluations.

Evaluating a dataset, continued

Determining expected emission value and range

To determine an expected emission value and range, perform the following steps:

Step	Action
5	Calculate the expected emissions value as the mean value of the dataset, excluding outliers. However, if a different method is deemed more appropriate, that different method may be used. In this case, document the different method and all assumptions.
6	Calculate the range of the expected emissions at $\pm 4\sigma$ of the expected value. The 4σ range is considered reasonable because such a variation still does not significantly approach the 10 mrem/year standard. Use best technical judgment to select a data set for calculating the standard deviation, typically 6 months or so. Do the calculation using the normal standard deviation equation for data sets. However, if a different method than using 4σ is deemed more appropriate, that different method may be used. In this case, document the different method and all assumptions. If the expected upper range is calculated to be less than twice the MDE, use twice the MDE as the upper range.
7	For each dataset evaluation, fully document all assumptions and calculations. Include, at a minimum, the following: • the complete dataset • any identified outliers • method(s) for outlier detection • the expected emissions range • method(s) for determining the expected emissions range • any assumptions made in determining the expected emissions range and the justification for these assumptions

Evaluating data validity

Data validity

Before reporting an emissions value, ensure the data used to develop the emissions value are valid. Perform these evaluations as data become available.

Evaluating tritium bubbler data

LANL uses tritium bubblers to determine the amount of HT and HTO released from a sampled stack. ESH-17 calculates these emissions according to ESH-17-112.

Steps to determine validity

To determine the validity of tritium data, perform the following steps:

Step	Action
1	Evaluate the validity of the bubbler vial weights according to the following criteria: • Are all weights recorded? • Are empty vial weights between 75 and 90 grams? • Are the glycol weights between 30 and 40 grams?
2	Evaluate the validity of the reported vial activities according to the following criteria: • Does the sample ID number on the HPAL analysis report form match the ID number on the Tritium bubbler data sheet? • Are all vial activities recorded? • Are the activity concentrations in vials A-C decreasing? • Are the activity concentrations in vials D-F decreasing? • Are the activity concentrations in vials C and F substantially less than those in vials A and D, respectively?

Evaluating data validity, continued

Step	Action
3	Evaluate the validity of the calculated emissions according to the following criterion: • Are the calculated emissions consistent with expected emissions and operations? This can be determined by comparing the calculated emissions with the expected range. See the *Evaluating a dataset* chapter in this procedure. If a problem is noted, ensure the correct data were used to calculate the emissions value. Include flow rates, analysis data, and field data.
4	If any of the criteria in steps 1 - 3 are not met and cannot be resolved, document the problem and whether the problem invalidates the sample. Make this decision using best judgment. Attach all assumptions and calculations to the appropriate datasheet(s) generated in ESH-17-112. Indicate on the datasheet(s) that you have evaluated the data in accordance with steps 1 - 4 of this procedure.
5	Review results and decisions with a qualified individual to ensure reasonableness.

NOTE: The above steps are provided as guidance for determining the validity of tritium bubbler data. Other situations may arise that potentially invalidate the samples and must be handled on an individual basis. Attach all documentation to the appropriate report(s) generated in ESH-17-112.

Address any recurring or unusual problems according to ESH-17-026, "Deficiency Reporting and Correcting."

All valid data are used to determine emissions. A comments field in the database allows for qualification of data.

Evaluating data validity, continued

Evaluation of particulate/ vapor emissions data

ESH-17 uses paper/charcoal filters to sample particulate/vapor radioactive stack emissions. These filters are analyzed to determine activity. ESH-17 calculates emissions, using the activity data, in accordance with ESH-17-114.

Steps to determine validity

To determine the validity of calculated emissions data, perform the following steps:

Step	Action
1	Evaluate the validity of the reported filter activities for gross alpha and gross beta activity according to the following criteria: • From information provided by Rad-NESHAPs project personnel, ESH-1/RCTs, and/or ESH-4/HPAL, was the sample damaged prior to counting?
2	Evaluate the validity of the reported filter activities for gamma spectroscopy according to the following criteria: • From information provided by Rad-NESHAPs project personnel, ESH-1/RCTs, and/or ESH-4/HPAL, was the sample damaged prior to counting? • Are the identified isotopes expected? This may be determined by conferring with operations personnel or by evaluating historical emissions.
3	Evaluate the validity of the reported emissions according to the following criteria: • Are the calculated emissions expected? This can be determined by comparing the calculated emissions with the expected range. See the *Evaluation of a dataset* chapter in this procedure. If a problem is noted, ensure the correct data were used to calculate the emissions value. Include flow rates, analysis data, and field data.
4	If any of the criteria in steps 1 - 3 are not met and cannot be resolved, document the problem and whether the problem invalidates the sample. Make this decision using best judgment. Attach all assumptions and calculations to the appropriate datasheet(s) generated in ESH-17-114. Indicate on the datasheet(s) that you have evaluated the data in accordance with steps 1 - 4 of this procedure.

Evaluating data validity, continued

NOTE: The previous steps are provided as guidance for determining the validity of particulate/vapor emissions data. Other situations may arise which potentially invalidate the samples and must be handled on an individual basis. Attach all documentation to the appropriate datasheet(s) generated in ESH-17-114.

Address any recurring or unusual problems according to ESH-17-026, "Deficiency Reporting and Correcting."

All valid data are used to determine emissions. A "comments" field in the database allows for qualification of data.

Estimating missing data

Missing data

Missing data are inevitable. However, when reporting radioactive air emissions, it is necessary to provide the best estimate of actual emissions. When estimating actual emissions, make every effort to be realistic, but the first priority is to ensure that emissions are not underestimated. For emissions reporting purposes, use all data that are deemed valid to determine annual emissions. Perform this part of the procedure as necessary for estimating missing/invalid data.

Representativeness of emissions

If percent collection for a data point is significantly less than 100% (e.g., < 85%), ensure that those emissions that have been measured are representative of the entire sampling period. This is done through the use of process knowledge and interaction with the facility personnel.

Steps to determine representativeness

To determine representativeness for a given sample, perform the following steps:

Step	Action
1	Determine the percent collection. **If percent collection is. . .** / **then. . .** less than 85% / go to Step 2. greater than or equal to 85% / go to Step 3.
2	Assume measured emissions are not representative of the entire sample period, unless evidence to the contrary can be developed. Go to Step 5.
3	Assume measured emissions are representative of the sample period, unless evidence to the contrary can be developed. Go to Step 4.
4	If data are considered representative, the emissions during the entire period may be estimated by scaling the data to include the entire period. For example, if the percent completeness is 90%, and the measured emission is 1 μCi during the collection, then the estimated emission during the entire sample period is (1 μCi) * (1/0.9) = 1.1 μCi. This step completes the estimation of missing data. Do not continue with Step 5. **Note:** If a method other than the above is determined appropriate for use, then document all assumptions and calculations. Attach these assumptions and calculations to the appropriate report(s) or datasheet(s) generated in ESH-17-112 or ESH-17-114.

Estimating missing data, continued

Step	Action
5	In the event that measured emissions have been determined not representative of the entire sample period, several options exist. It is the responsibility of the person performing the calculations to determine the best method for estimating emissions and to completely document all assumptions and calculations. When necessary, contact facility personnel to help determine representativeness. Some possible methods for estimating emissions are provided below: • If measured emissions can be shown to be higher than emissions during the lost sample time, the estimated emissions may be determined by using a simple ratio as in Step 4. Ensure that overestimates do not impact calculated doses or facility operations. • If measured emissions can be shown to be lower than emissions during the lost sample time, missing data may be estimated by determining emissions during similar operations and using these values as guidance. • If an analysis is missing for one sample (e.g., alpha activity), the missing data may be estimated based on available data (e.g., beta activity and gamma activity) and/or results during similar operations and conditions. **Note:** These methods are only guidance. Review each situation independently and determine the best method for the situation. Attach all calculations and assumptions to the appropriate report(s) or datasheet(s) generated in ESH-17-112 or ESH-17-114.

Evaluating a data point against the expected range

Data point evaluation against expected range

After determining the range of expected emissions values, evaluate future data points against this range. Perform this part of the procedure as data become available.

To calculate the expected range, select a reasonable time period for the data set (about 6 months). However, the exact time frame is arbitrary, based on technical judgment and may be changed as appropriate.

Steps for data point evaluation

To evaluate data points against the expected range, perform the following steps:

Step	Action
1	Determine the appropriate range for the stack and emission type. **If the value is. . .** / **then. . .** within the expected range / go to Step 2. outside the expected range / go to Step 3.
2	Unless other problems are noted with the data, it is acceptable and within normal limits. Go to Step 5.
3	Make sure the data value was calculated correctly. If the data value is correct, ensure that the range in use is representative of emissions (e.g., has the facility come out of shutdown).
4	If the emission is above the expected range for the existing conditions, follow the steps in ESH-17-118, "Categorizing and Reporting Increased Airborne Radioactive Emissions from Sampled Stacks."
5	Sign the data sheet, generated in accordance with ESH-17-114 or ESH-17-112, indicating that it has been reviewed according to this procedure.

Evaluating expected emissions for off-site dose

Lab-wide dose assessment

The dose to potential LANL MEIs is calculated annually to determine and demonstrate compliance with 40 CFR 61, Subpart H. This calculation is performed in accordance with ESH-17-501 and ESH-17-503.

In addition to this dose calculation to annually check emissions, ESH-17 also periodically tracks the dose from emissions during the year to ensure that the Laboratory does not exceed the 10 mrem/yr standard. One method for accomplishing this task is through a periodic Lab-wide dose assessment. The following steps outline this process. Perform these steps whenever a new emissions range is calculated according to the chapter *Evaluating a dataset* in this procedure.

Steps for tritium emitting stacks

To perform a Lab-wide dose assessment for tritium emitting stacks, perform the following steps:

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>For each tritium emitting stack, sum year-to-date emissions.</td></tr>
<tr><td>2</td><td>For each tritium-emitting stack, determine the maximum expected emissions value for the remainder of the year.

For example, if the maximum expected emissions rate is 100 μCi/hr (from Evaluation of a dataset, Step 6), and 1000 hrs remain in the year, then the maximum expected emissions value for the rest of the year is 100 μCi/hr * 1000 hr = 1.0E+05 μCi.</td></tr>
<tr><td>3</td><td>Add the values determined in steps 1 and 2. Use this total as the source term for each respective stack.</td></tr>
<tr><td>4</td><td>As an initial check, the emissions from all stacks may be summed and modeled from the LANSCE FE-3 stack, using CAP88 in accordance with ESH-17-501 or using CAP88PC.
<table>
<tr><th>If this calculated dose is…</th><th>then…</th></tr>
<tr><td>less than 0.1 mrem</td><td>no additional dose assessments are necessary. Go to Step 8.</td></tr>
<tr><td>0.1 mrem or greater</td><td>continue with Step 5.</td></tr>
</table></td></tr>
<tr><td>5</td><td>Calculate the dose to the LANL MEI from each stack using CAP88 (or CAP88PC) in accordance with ESH-17-501. Use averaged meteorological files for this assessment. Print a copy of CAP88OUT for each assessment performed. If CAP88PC is used, print copies of summary reports in lieu of CAP88OUT.</td></tr>
<tr><td>6</td><td>Sum the total dose to the LANL MEI from the tritium-emitting stacks.</td></tr>
</table>

Evaluating expected emissions for off-site dose, cont.

Step	Action
7	If this total is greater than 0.1 mrem, inform the Rad-NESHAP Project Leader of the result in writing and that emissions/operations should be reviewed to ensure that they do not impact compliance with the 10 mrem/yr dose standard.
8	Document all calculations, assumptions, and dose assessments.

Steps for particulate/ vapor emitting stacks

To perform a Lab-wide dose assessment for particulate/vapor emitting stacks, perform the following steps:

Step	Action
1	For each particulate/vapor-emitting stack, sum calendar year-to-date emissions.
2	For each particulate/vapor-emitting stack, determine the maximum expected emissions value for the remainder of the year. For example, if the maximum expected emissions rate is 100 μCi/hr (from Evaluation of a dataset, Step 6), and 1000 hrs remain in the year, then the maximum expected emissions value for the rest of the year is 100 μCi/hr * 1000 hr = 1.0E+05 μCi.
3	Add the values determined in steps 1 and 2. Use this total as the source term for each respective stack.
4	As an initial check, the emissions from all stacks may be summed and modeled from the LANSCE ES-3 stack, using CAP88 in accordance with ESH-17-501 or using CAP88PC.
5	Calculate the dose to the LANL MEI, from each stack, using CAP88 (or CAP88PC) in accordance with ESH-17-501. Use three-year average meteorological files for this assessment. Print a copy of CAP88OUT for each assessment performed. If CAP88PC is used, print copies of summary reports in lieu of CAP88OUT.
6	Sum the total dose to the LANL MEI from the particulate/vapor emitting stacks.

If this calculated dose is…	then…
less than 0.5 mrem	no additional dose assessments are necessary. Go to Step 8.
0.5 mrem or greater	continue with Step 5.

Evaluating expected emissions for off-site dose, cont.

Step	Action
7	If this total is greater than 0.5 mrem, inform the Rad-NESHAP Project leader of the result in writing and that emissions/operations should be reviewed to ensure that they do not impact compliance with the 10 mrem/yr dose standard.
8	Document all calculations, assumptions, and dose assessments.

Evaluating regulatory compliance

Regulatory compliance

40 CFR 61, Subpart H, requires the sampling of all stacks with the potential to cause any member of the public to receive a dose of 0.1 mrem in a year. Each potential point source is evaluated against this requirement in accordance with ESH-17-102. For each stack that requires sampling, detailed sampling requirements are developed and documented in accordance with ESH-17-121.

To help ensure that each stack is sampled adequately, the annual percent completeness must be calculated. For each stack, a percent completeness of 85% is the minimum acceptable value (see ESH-17-RN).

Annual percent completeness

Annual percent completeness is based on the total amount of data collected versus the total amount of data that can be potentially collected. For example, if a sample period was 168 hrs and the sampler uptime was 150 hrs, then the percent data collected for this aspect was 150/168 * 100% = 89%. Additionally, if this sample was scheduled for three required analyses (e.g., gross alpha, gross beta, and gamma spectroscopy), and only two of the analyses were performed before a sample was damaged, then the total percent completeness is 2/3 *0.89 *100% = 59%.

Steps to determine percentage completeness

To determine the percent completeness of a sample as described above, complete the following steps:

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>Determine sample collection status.
<table>
<tr><th>If a sample. . .</th><th>then. . .</th></tr>
<tr><td>was collected for the sample period (e.g., not broken, damaged, or otherwise deemed invalid)</td><td>go to Step 2.</td></tr>
<tr><td>was not collected for the sample period (e.g., deemed invalid)</td><td>the percent collection is 0%. Go to Step 5.</td></tr>
</table></td></tr>
<tr><td>2</td><td>Divide the total sample time (hrs) by the amount of time that could possibly have been sampled (hrs). This is the percent collection for the period.</td></tr>
</table>

Evaluating regulatory compliance, continued

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>3</td><td>Determine sample analysis status.
<table>
<tr><th>If all analytical data. . .</th><th>then. . .</th></tr>
<tr><td>were collected for the sample (e.g., deemed valid)</td><td>analytical percent collection is 100%. Go to Step 5.</td></tr>
<tr><td>were not collected for the sample (e.g., deemed invalid or partial analysis was performed)</td><td>go to Step 4.</td></tr>
</table></td></tr>
<tr><td>4</td><td>Divide the total number of analytical data points collected by the total number required and multiply by 100%. This is the analytical percent collection for the sample period.</td></tr>
<tr><td>5</td><td>The total percent completeness for the sample period is the product of the percent collection (in decimal form) from steps 1 & 2 and the analytical percent collection (in decimal form) from steps 3 & 4.</td></tr>
<tr><td>6</td><td>Annual percent completeness is the average of the percent completeness calculated year-to-date. Calculate the year-to-date completeness at least annually to ensure that percent completeness for each stack is at an acceptable level. If these checks indicate that a stack may have an annual percent completeness of less than 85%, inform ESH-17 group management in writing. Submit this documentation, including any assumptions and calculations, to the Records Coordinator.</td></tr>
<tr><td>7</td><td>When data become available for an entire calendar year, calculate the annual percent completeness for each stack. Report these values to ESH-17 group management. Submit this documentation to the records coordinator in accordance with the Records resulting from this procedure chapter of this procedure.</td></tr>
</table>

Records resulting from this procedure

Records

The following records generated as a result of this procedure are to be submitted **within two weeks of generation** as records to the records coordinator:

- Annual evaluation of year-to-date percent completeness
- Report on annual percent completeness to group management
- Dataset evaluations, including any assumptions, calculations, and/or plots
- Evaluations of off-site dose impacts, including any assumptions, calculations, and/or CAP88 output files
- Correspondence between the performer of this procedure and project management addressing concerns over radioactive stack emissions data

The records listed above are to be submitted to the records coordinator **prior to submission of the annual Rad-NESHAP compliance report.** All other calculations and assumptions resulting from this procedure will be documented using the reports and datasheets generated during the performance of procedures ESH-17-112 and ESH-17-114. These calculations and assumptions are submitted to the records coordinator in accordance with these procedures.

Click here to record “self-study” training to this procedure.